

Forecast Comparisons

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Three other organizations—Standard & Poor’s DRI (DRI), the WEFA Group (WEFA), and the Gas Research Institute (GRI) [95]—also produce comprehensive energy projections with a time horizon similar to that of *AEO2001*. The most recent projections from those organizations (DRI, Spring/Summer 2000; WEFA, 1st Quarter 2000; GRI, January 2000), as well as other forecasts that concentrate on petroleum, natural gas, and international oil markets, are compared here with the *AEO2001* projections.

Economic Growth

Differences in long-run economic forecasts can be traced primarily to different views of the major supply-side determinants of growth in gross domestic product (GDP): labor force and productivity change (Table 19). In comparison with the *AEO2001* and DRI reference cases, the WEFA forecast shows the highest economic growth, including a higher growth rate for the labor force. The *AEO2001* long-run forecast of average annual economic growth from 1999 to 2020 in the reference case is 3.0 percent—0.9 percent higher than the *AEO2000* forecast.

The June 26, 2000, mid-session review by the Office of Management and Budget projected real GDP growth of 3.1 percent per year between 1999 and 2010. *AEO2001* projects annual growth of 3.3 percent over the same period.

World Oil Prices

Comparisons with other oil price forecasts—including the International Energy Agency (IEA), Petroleum Economics Ltd. (PEL), Petroleum Industry Research Associates, Inc. (PIRA), Natural Resources Canada (NRCan), and Deutsche Banc Alex. Brown (DBAB)—are shown in Table 20 (IEA, 1998; PEL, February 2000; PIRA, October 2000; NRCan, April 1997; DBAB, June 2000). With the exception of IEA and PEL, the range between the *AEO2001* low and high world oil price cases spans the range of other published forecasts.

Total Energy Consumption

The *AEO2001* forecast of end-use sector energy consumption over the next two decades shows far less volatility than has occurred historically. Between 1974 and 1984, volatile world oil markets dampened domestic oil consumption. Consumers switched to electricity-based technologies in the buildings sector,

while in the transportation sector new car fuel efficiency nearly doubled. Natural gas use declined as a result of high prices and limitations on new gas hookups. Between 1984 and 1995, however, both petroleum and natural gas consumption rebounded, bolstered by plentiful supplies and declining real energy prices. As a consequence, new car fuel efficiency in 1995 was less than 2 miles per gallon higher than in 1984, and natural gas use (residential, commercial, and industrial) was almost 25 percent higher than it was in 1984.

Given potentially different assumptions about, for example, technological developments over the next 20 years, the forecasts from DRI, GRI, and WEFA have remarkable similarities with the *AEO2001* projections. Electricity is expected to remain the fastest growing source of delivered energy (Table 21), although its projected rate of growth is down sharply from historical rates in each of the forecasts, because many traditional uses of electricity (such as for air conditioning) approach saturation while

Table 19. Forecasts of economic growth, 1999-2020

Forecast	Average annual percentage growth		
	Real GDP	Labor force	Productivity
AEO2001			
Low growth	2.5	0.7	1.8
Reference	3.0	0.9	2.1
High growth	3.5	1.2	2.3
DRI			
Low	2.3	0.7	1.6
Reference	2.9	0.9	2.0
High	3.6	1.0	2.6
WEFA			
Low	2.8	0.9	1.8
Reference	3.2	1.1	2.1
High	3.5	1.3	2.3

Note: Totals may not equal sum of components due to independent rounding.

Table 20. Forecasts of world oil prices, 2000-2020
1999 dollars per barrel

Forecast	2000	2005	2010	2015	2020
<i>AEO2001</i> reference	27.59	20.83	21.37	21.89	22.41
<i>AEO2001</i> high price	27.59	26.04	26.66	28.23	28.42
<i>AEO2001</i> low price	27.59	15.10	15.10	15.10	15.10
DRI	26.65	19.47	18.65	19.87	21.16
IEA	20.43	20.43	20.43	30.04	30.04
PEL	17.69	15.63	13.77	11.75	NA
PIRA	30.04	22.56	23.58	NA	NA
WEFA	23.76	18.39	18.48	19.42	20.41
GRI	18.17	18.17	18.17	18.17	NA
NRCan	21.24	21.24	21.24	21.24	21.24
DBAB	23.67	17.08	17.36	17.34	17.68

NA = not available.

average equipment efficiencies rise. Petroleum use and natural gas consumption are projected to grow at rates similar to those of recent years. For other fuels, future growth in consumption is expected to slow as a result of moderating economic growth, fuel switching, and increased end-use efficiency.

Residential and Commercial Sectors

Growth rates for energy demand in the residential and commercial sectors are expected to decrease by more than 25 percent from the rates between 1984 and 1998, largely because of projected lower growth in population, housing starts, and commercial floorspace additions. Other contributing factors include increasing energy efficiency due to technical innovations and legislated standards; voluntary government efficiency programs; and reduced opportunities for additional market penetration of such end uses as air conditioning.

Differing views on the growth of new uses for energy contribute to variations among the forecasts. By fuel, electricity (excluding generation and transmission losses) remains the fastest growing energy source for both sectors across all forecasts (Table 22). All the forecasts project substantial growth in electricity use, with the *AEO2001*, DRI, and WEFA projections showing slower growth toward the end of the forecast. Natural gas use also is projected to grow but at lower rates, and projected petroleum use either is stable or continues to fall. GRI projects a more rapid decline in oil use, particularly for commercial space and water heating, than the other forecasts.

Industrial Sector

The projected growth rates for delivered energy consumption in the industrial sector range from 1.0 percent to 1.4 percent per year (Table 23). The *AEO2001* forecast is in the middle, at 1.2 percent. Generally, the projected growth rates are somewhat lower than the actual rates from 1984 to 1998. The decline is attributable to lower growth for GDP and manufacturing output. In addition, there has been a continuing shift in the industrial output mix toward less energy-intensive products.

The growth rates for different fuels in the industrial sector between 1984 and 1998 reflect a shift from petroleum products and coal to greater reliance on natural gas and electricity. In all the forecasts, natural gas use is expected to grow more slowly than in

Table 21. Forecasts of average annual growth rates for energy consumption (percent)

Energy use	History		Projections			
	1974-1984	1984-1998	AEO2001 (1999-2020)	DRI (1999-2020)	GRI (1998-2015)	WEFA (1999-2020)
Petroleum*	-0.1	1.3	1.5	1.6	1.2	1.1
Natural gas*	-1.7	1.4	1.4	1.2	1.8	1.0
Coal*	-3.0	-1.8	0.2	0.0	-0.8	-0.2
Electricity	3.0	2.5	1.8	1.4	2.0	1.6
Delivered energy	-0.2	1.4	1.5	1.4	1.4	1.1
Electricity losses	2.5	1.8	0.9	0.3	1.1	0.2
Primary energy	0.4	1.5	1.3	1.1	1.3	0.8

*Excludes consumption by electric utilities.

Table 22. Forecasts of average annual growth in residential and commercial energy demand (percent)

Forecast	History	Projections			
	1984-1998	AEO2001 (1999-2020)	DRI (1999-2020)	GRI (1998-2015)	WEFA (1999-2020)
Residential					
Petroleum	-0.1	-0.7	0.2	-0.3	-0.6
Natural gas	0.0	1.3	1.1	1.4	1.1
Electricity	2.7	1.9	1.3	2.0	1.7
Delivered energy	1.1	1.3	1.0	1.3	1.1
Electricity losses	2.2	1.0	0.2	1.2	0.3
Primary energy	1.6	1.2	0.7	1.2	0.7
Commercial					
Petroleum	-4.3	0.5	-0.5	-1.3	-0.5
Natural gas	1.3	1.3	0.5	1.8	1.3
Electricity	3.4	2.0	1.0	1.9	1.8
Delivered energy	1.4	1.6	0.9	1.6	1.4
Electricity losses	3.0	1.2	0.0	1.0	0.4
Primary energy	2.2	1.4	0.4	1.3	0.8

Table 23. Forecasts of average annual growth in industrial energy demand (percent)

Forecast	History	Projections			
	1984-1998	AEO2001 (1999-2020)	DRI (1999-2020)	GRI (1998-2015)	WEFA (1999-2020)
Petroleum	1.0	1.1	1.1	1.6	1.2
Natural gas	2.2	1.3	1.3	1.7	0.7
Coal	-1.6	0.1	0.0	-0.8	-0.4
Electricity	1.6	1.4	1.8	2.0	1.2
Delivered energy	1.4	1.2	1.1	1.4	1.0
Electricity losses	0.8	0.5	0.6	1.4	-0.2
Primary energy	1.3	1.0	0.9	1.4	0.7

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recent history, because much of the potential for fuel switching was realized during the 1980s. A key uncertainty in industrial coal forecasts is the environmental acceptability of coal as a boiler fuel.

Transportation Sector

Overall fuel consumption in the transportation sector is expected to grow slightly more slowly than in the recent past in each of the forecasts (Table 24). All the forecasts anticipate continued rapid growth in air travel and considerably slower growth in light-duty vehicle travel. Demand for diesel fuel is expected to grow more slowly in all the forecasts than it has in the past.

GRI and WEFA project slower growth in gasoline demand as a result of slower growth in light-duty vehicle travel, and GRI projects more rapid efficiency improvements. GRI also projects the slowest growth in air travel of all the forecasts, leading to slower growth in jet fuel demand. For diesel fuel, however, GRI projects rapid growth in demand comparable to the *AEO2001* forecast, because it projects similar annual growth in freight travel.

Electricity

Comparison across forecasts shows slight variation in projected electricity sales (Table 25). Sales projections for 2020 range from 1,485 billion kilowatthours (DRI) to 1,610 billion kilowatthours (WEFA) for the residential sector, as compared with the *AEO2001* reference case value of 1,701 billion kilowatthours. The forecasts for total electricity sales in 2020 range from 4,450 billion kilowatthours (DRI) to 4,503 billion kilowatthours (WEFA), compared with the *AEO2001* reference case value of 4,804 billion kilowatthours. All the projections for total electricity sales in 2020 fall below the range of the *AEO2001* low and high economic growth cases (4,516 and 5,135 billion kilowatthours, respectively). Different assumptions related to expected economic activity, coupled with diversity in the estimation of penetration rates for energy-efficient technologies, are the primary reasons for variation among the forecasts. All the forecasts compared here agree that stable fuel prices and slow growth in electricity demand relative to GDP growth will tend to keep the price of electricity stable—or declining in real terms—until 2020.

Table 24. Forecasts of average annual growth in transportation energy demand (percent)

Forecast	History		Projections			
	1975-1985	1985-1997	AEO2001 (1999-2020)	DRI (1999-2020)	GRI (1998-2015)	WEFA (1999-2020)
Consumption						
<i>Motor gasoline</i>	0.2	1.4	1.4	1.7	1.1	0.7
<i>Diesel fuel</i>	4.2	3.3	2.3	1.2	1.9	1.2
<i>Jet fuel</i>	2.1	2.4	2.6	3.1	2.5	3.0
<i>Residual fuel</i>	1.0	-0.7	0.8	2.2	3.2	2.5
<i>All energy</i>	1.0	2.7	1.8	1.9	1.2	1.1
Key indicators						
<i>Car and light truck travel</i>	2.9	3.1	1.9	1.9	1.5	1.6
<i>Air travel (revenue passenger-miles)</i>	7.3	4.9	3.6	4.3	3.0	3.7
<i>Average new car fuel efficiency</i>	5.5	0.4	0.7	0.4	2.1	0.5
<i>Gasoline prices</i>	0.5	-2.7	0.6	0.3	0.9	0.2

NA = not available.

Both the DRI and GRI forecasts assume that the electric power industry will be fully restructured, resulting in average electricity prices that approach long-run marginal costs. *AEO2001* also assumes that competitive pressures will grow and continue to push prices down until the later years of the projections. *AEO2001* also assumes that increased competition in the electric power industry will lead to lower operating and maintenance costs, lower general and administrative costs, early retirement of inefficient generating units, and other cost reductions. Further, in the DRI forecast, it is assumed that time-of-use electricity rates will cause some flattening of electricity demand (lower peak period sales relative to average sales), resulting in better utilization of capacity and capital cost savings.

The distribution of sales among sectors affects the mix of capacity types needed to satisfy sectoral demand. Although the *AEO2001* mix of capacity among fuels is similar to those in the other forecasts, small differences in sectoral demands across the forecasts could lead to significant differences in the expected mix of capacity types. In general, recent growth in the residential sector, coupled with an oversupply of baseload capacity, results in a need for more peaking and intermediate capacity than baseload capacity. Consequently, generators are expected to plan for more combustion turbine and combined-cycle technology than coal, oil, or gas steam capacity.

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Table 25. Comparison of electricity forecasts (billion kilowatthours, except where noted)

Projection	AEO2001			Other forecasts		
	Reference	Low economic growth	High economic growth	WEFA	GRI	DRI
2015						
Average end-use price (1999 cents per kilowatthour)	5.9	5.7	6.1	5.8	6.0	5.4
Residential	7.5	7.2	7.8	7.1	7.6	6.7
Commercial	6.0	5.7	6.4	6.3	6.9	5.7
Industrial	3.8	3.6	4.1	3.9	3.4	3.8
Net energy for load	4,771	4,564	5,011	4,842	4,812	4,783
Coal	2,246	2,176	2,362	2,026	2,337	2,267
Oil	17	17	18	51	85	174
Natural gas	1,266	1,145	1,373	1,764	1,158	1,257
Nuclear	639	632	650	508	531	640
Hydroelectric/other ^a	395	390	398	448	472	411
Nonutility sales to grid ^b	187	184	190	NA	185	NA
Net imports	21	21	21	44	44	34
Electricity sales	4,484	4,286	4,715	4,210	4,489	4,173
Residential	1,573	1,540	1,600	1,494	1,573	1,388
Commercial/other ^c	1,602	1,532	1,673	1,419	1,448	1,365
Industrial	1,309	1,214	1,442	1,296	1,469	1,421
Capability (gigawatts) ^{d,e}	1,061	1,020	1,112	961	962	1,084
Coal	324	319	337	302	327	355
Oil and gas	541	500	569	461	411	516
Nuclear	80	78	81	64	78	95
Hydroelectric/other ^a	117	123	126	134	146	118
2020						
Average end-use price (1999 cents per kilowatthour)	6.0	5.6	6.4	5.6	NA	5.8
Residential	7.6	7.2	8.0	6.8	NA	6.5
Commercial	6.2	5.7	6.7	6.0	NA	5.6
Industrial	4.0	3.6	4.3	3.8	NA	3.6
Net energy for load	5,094	4,792	5,437	5,180	NA	5,090
Coal	2,298	2,205	2,614	2,177	NA	2,395
Oil	19	17	22	48	NA	189
Natural gas	1,587	1,409	1,584	2,005	NA	1,462
Nuclear	574	554	591	433	NA	604
Hydroelectric/other ^a	396	392	399	472	NA	409
Nonutility sales to grid ^b	200	195	207	NA	NA	NA
Net imports	21	21	21	44	NA	31
Electricity sales	4,804	4,516	5,135	4,503	NA	4,450
Residential	1,701	1,645	1,736	1,610	NA	1,485
Commercial/other ^c	1,692	1,595	1,794	1,528	NA	1,427
Industrial	1,411	1,276	1,604	1,365	NA	1,538
Capability (gigawatts) ^{d,e}	1,132	1,068	1,201	1,021	NA	1,139
Coal	325	317	366	317	NA	373
Oil and gas	609	558	635	511	NA	560
Nuclear	72	69	74	54	NA	89
Hydroelectric/other ^a	126	124	127	139	NA	118

^a“Other” includes conventional hydroelectric, geothermal, wood, wood waste, municipal solid waste, other biomass, solar and wind power, plus a small quantity of petroleum coke. For nonutility generators, “other” also includes waste heat, blast furnace gas, and coke oven gas.

^bFor AEO2001, includes only net sales from cogeneration; for the other forecasts, also includes nonutility sales to the grid.

^c“Other” includes sales of electricity to government, railways, and street lighting authorities.

^dFor DRI, “capability” represents nameplate capacity; for the others, “capability” represents net summer capability.

^eGRI generating capability includes only central utility and independent power producer capacity. It does not include cogeneration capacity in the commercial and industrial sectors, which would add another 107 gigawatts.

Sources: **AEO2001:** AEO2001 National Energy Modeling System, runs AEO2001.D101600A (reference case), LM2001.D101600A (low economic growth case), and HM2001.D101600A (high economic growth case). **WEFA:** The WEFA Group, *U.S. Energy Outlook* (2000). **GRI:** Gas Research Institute, *GRI Baseline Projection of U.S. Energy Supply and Demand*, 2000 Edition (January 2000). **DRI:** Standard & Poor's DRI, *U.S. Energy Outlook* (Spring/Summer 2000).

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Natural Gas

The differences among published forecasts of natural gas prices, production, consumption, and imports (Table 26) indicate the uncertainty of future market trends. Because the forecasts depend heavily on the underlying assumptions that shape them, the assumptions should be considered when different projections are compared. For instance, the forecast from GRI incorporates a cyclical price trend based on exploration and production cycles, which can be deceptive when isolated years are considered. In both 2015 and 2020, the forecast with the highest natural gas consumption is the *AEO2001* high economic growth forecast (33.36 and 36.09 trillion cubic feet, respectively); and the forecast with the lowest level is the DRI forecast (29.46 and 28.58 trillion cubic feet, respectively).

The National Petroleum Council (NPC) forecast shows the greatest expected growth in natural gas consumption between 1999 and 2015 in the residential and commercial sectors. The DRI forecast shows the lowest growth between 1999 and 2015 and also between 1999 and 2020. For residential consumption in 2015, the expected percentage increase over 1999 is 10 percentage points higher in the NPC forecast than in the DRI forecast; for commercial consumption the difference is 23 percentage points. The DRI forecast for commercial consumption is significantly lower than the other forecasts, due in part to definitional differences, and is even lower for 2020 than for 2015. Both the *AEO2001* reference and high economic growth forecasts for residential and commercial consumption exceed the other forecasts for 2020.

For industrial sector consumption of natural gas, the WEFA and DRI forecasts are not strictly comparable with the others because of differences in definitions. Among the remaining forecasts, the *AEO2001* reference, low economic growth, and high economic growth cases all project lower consumption in 2015 than do the GRI, AGA, and NPC reference cases. All the forecasts project the strongest growth in natural gas consumption for the electricity generation sector.

Domestic natural gas consumption is met by domestic production and imports. DRI projects the highest level of net imports, as well as the highest share of

imports relative to total supply, in both 2015 and 2020. GRI's projection for 2015 is 1.7 trillion cubic feet lower than DRI's, corresponding to projected import shares of total supply at 12 percent and 19 percent, respectively. The forecasts available for 2020 are much more closely aligned. In general the projections for domestic production levels among the forecasts correspond to their projections for domestic consumption. GRI projects the highest production level in 2015, as well as relatively low import levels.

Even with production levels closer to the mid-range, the NPC forecast projects the highest wellhead price in 2015. At the other extreme, GRI projects the lowest wellhead price and the highest production levels. By 2020 the wellhead price forecasts from WEFA and DRI fall within the range of the *AEO2001* low and high economic growth cases, but both the WEFA and DRI forecasts for domestic production are lower than that in the *AEO2001* low economic growth case. With one exception, all the forecasts for end-use prices follow the same ranking from highest to lowest as do the wellhead price forecasts for both 2015 and 2020.

For the residential and commercial sectors in 2015, WEFA projects the highest end-use margins relative to the wellhead. The lowest projections for residential (GRI) and commercial (AGA) margins are \$1.10 and \$1.02 per thousand cubic feet lower than WEFA's, respectively, a noticeable difference. The GRI forecast, projecting relatively low residential and commercial margins, projects the highest margin to electricity generators in 2015, at \$0.23 above the lowest (AGA). AGA generally projects the lowest margins, but they do not include some State and local taxes. Because of definitional differences industrial prices are not as readily comparable, although on-system sale prices would generally be expected to be higher than an estimate of the average price to all industrial customers. With the exception of the *AEO2001* high economic growth case, margins to the industrial sector are expected to decline through 2015 in all the forecasts. The *AEO2001* and NPC forecasts project declines of less than 10 percent in the industrial margin from 1998 to 2015, whereas the projected decline in the GRI and AGA forecasts is over 20 percent.

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Table 26. Comparison of natural gas forecasts (trillion cubic feet, except where noted)

Projection	AEO2001			Other forecasts				
	Reference	Low economic growth	High economic growth	WEFA	GRI ^a	DRI	AGA	NPC
2015								
Lower 48 wellhead price (1999 dollars per thousand cubic feet)	2.83	2.59	3.20	2.64	1.89	2.79	2.56	3.67
Dry gas production^b	26.24	24.63	27.86	24.43	28.58	24.00	26.71	26.50
Net imports	5.50	5.35	5.62	5.35	4.01	5.70	4.15	4.70
Consumption	31.61	29.85	33.36	30.13	32.78	29.46	30.86	31.84
Residential	5.83	5.70	5.90	5.67	5.67	5.57	5.93	6.07
Commercial ^c	3.94	3.79	4.07	3.93 ^d	4.14	3.46 ^d	3.95	4.09
Industrial ^c	9.76	9.18	10.50	6.33 ^d	10.98	8.43 ^e	10.72	10.76
Electricity generators ^f	9.30	8.54	9.97	11.63 ^c	8.72	9.25 ^g	7.06	7.76
Other ^h	2.78	2.63	2.92	2.57	3.27	2.75	3.20	3.16 ⁱ
End-use prices (1999 dollars per thousand cubic feet)								
Residential	6.61	6.37	6.95	7.36	5.51	7.02	6.31 ^j	7.65
Commercial ^c	5.65	5.41	6.00	6.16 ^d	4.62	6.03	5.07 ^j	6.76
Industrial ^c	3.54	3.29	3.91	3.70 ^{d,k}	2.91 ^k	3.98 ^k	3.09 ^{j,l}	4.86 ^k
Electricity generators ^f	3.30	3.05	3.67	3.12 ^c	2.55	3.24	2.99 ^j	4.21
2020								
Lower 48 wellhead price (1999 dollars per thousand cubic feet)	3.13	2.66	3.68	2.72	NA	3.07	NA	NA
Dry gas production^b	29.04	26.74	30.38	25.72	NA	25.13	NA	NA
Net imports	5.80	5.58	5.82	5.72	NA	6.00	NA	NA
Consumption	34.73	32.22	36.09	31.82	NA	28.58	NA	NA
Residential	6.14	5.95	6.21	5.88	NA	5.84	NA	NA
Commercial ^c	4.02	3.83	4.19	4.05 ^d	NA	3.43 ^d	NA	NA
Industrial ^c	10.18	9.36	11.20	6.45 ^d	NA	8.82 ^e	NA	NA
Electricity generators ^f	11.34	10.23	11.29	12.72 ^c	NA	9.89 ^g	NA	NA
Other ^h	3.06	2.85	3.20	2.71	NA	2.88	NA	NA
End-use prices (1999 dollars per thousand cubic feet)								
Residential	6.73	6.32	7.24	7.44	NA	7.25	NA	NA
Commercial ^c	5.86	5.42	6.38	6.25 ^d	NA	6.26	NA	NA
Industrial ^c	3.86	3.38	4.43	3.78 ^{d,k}	NA	4.25 ^k	NA	NA
Electricity generators ^f	3.66	3.17	4.17	3.20 ^c	NA	3.52	NA	NA

^aThe baseline projection includes a cyclical price trend based on exploration and production cycles; therefore, forecast values for an isolated year may be misleading.

^bDoes not include supplemental fuels.

^cIncludes gas consumed in cogeneration.

^dExcludes gas used for cogenerators and other nonutility generation.

^eExcludes cogenerators' energy attributed to generating electricity

^fIncludes independent power producers and excludes cogenerators.

^gIncludes portion of cogeneration attributed to electricity generation

^hIncludes lease, plant, and pipeline fuel and fuel consumed in natural gas vehicles.

ⁱIncludes balancing item.

^jDoes not include certain State and local taxes levied on customers.

^kOn system sales or system gas (i.e., does not include gas delivered for the account of others).

^lVolume-weighted average of "system" gas and "transportation" gas.

NA = Not available.

Note: Assumed conversion factors: electricity generators, 1,022 Btu per cubic foot; other end-use sectors, 1,029 Btu per cubic foot; net imports, 1,022 Btu per cubic foot; production and other consumption, 1,028 Btu per cubic foot.

Sources: **AEO2001**: AEO2001 National Energy Modeling System, runs AEO2001.D101600A (reference case), LM2001.D101600A (low economic growth case), and HM2001.D101600A (high economic growth case). **WEFA**: The WEFA Group, *Natural Gas Outlook* (2000). **GRI**: Gas Research Institute, *GRI Baseline Projection of U.S. Energy Supply and Demand*, 2000 Edition (January 2000). **DRI**: Standard & Poor's DRI, *U.S. Energy Outlook* (Spring/Summer 2000). **AGA**: American Gas Association, *1999 AGA-TERA Base Case* (December 1999). **NPC**: National Petroleum Council, *Natural Gas, Meeting the Challenges of the Nation's Growing Natural Gas Demand* (December 1999).

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Petroleum

Projected prices for crude oil in the *AEO2001* low and high oil price cases (Table 27) bound the 2010 and 2020 projections in five other petroleum forecasts: the *AEO2001* reference case, WEFA, GRI, DRI, and the Independent Petroleum Association of America (IPAA). Comparisons with GRI and IPAA forecasts, which do not extend to 2020, apply only to 2010. *AEO2001* shows the highest reference case price path of the five forecasts. The *AEO2001* reference case projection for the world oil price in 2010 is \$2.89 per barrel above the WEFA projection, \$3.20 above GRI, and \$2.72 above DRI. In 2020, however, the *AEO2001* reference case projection is only \$2.00 per barrel above the WEFA projection and \$1.25 above the DRI projection.

Crude oil price forecasts are influenced by differing views of the projected composition of world oil production, such as the expansion of OPEC oil production and the timing of an expected recovery in East Europe/former Soviet Union oil production. Differences may also arise on the basis of different views of the strength of the U.S. economy and the timing and strength of economic recovery in southeast Asia.

All the forecasts except GRI project a significant decline in domestic oil production between 2000 and 2010, reflecting assumed declines in proved reserves. GRI projects a milder decline before 2005, followed by an upturn in production between 2005 and 2015. Both WEFA and DRI continue their downward production projections to 2020, at slower rates. *AEO2001* projects a sharper decline before 2010 than do the other four projections, resulting in a 2010 reference case projection for crude oil production that is at least 280,000 barrels per day below the other reference case forecasts.

The *AEO2001* reference case projects relatively little change in annual domestic oil production between 2010 and 2020, whereas the high world oil price case projects a slight recovery after 2010, leading to more production in 2020 than in 2010. As a result, projected production in 2020 in the *AEO2001* high oil price case is above the WEFA and DRI projections, whereas the *AEO2001* reference case projection is essentially the same as the WEFA projection. The

AEO2001 projections for production of natural gas liquids are within the range of the other forecasts. GRI projects the highest level of natural gas liquids production in 2010 at 2.69 million barrels per day and IPAA the lowest at 2.03 million barrels per day.

The three *AEO2001* cases, along with DRI and IPAA, project relatively high levels of petroleum consumption, mostly as a result of higher projections for gasoline consumption. WEFA and GRI project the lowest petroleum consumption in 2010 at around 21.5 million barrels per day. DRI projects the highest consumption in 2010, followed by IPAA, the *AEO2001* low oil price case, and the *AEO2001* reference case. DRI has the highest 2020 consumption projection, followed closely by the *AEO2001* low oil price case. The WEFA consumption projection is significantly lower than all other forecasts for 2020, mainly because WEFA expects lower consumption of transportation fuels. Despite a wide range of oil price assumptions, the three *AEO2001* cases show limited variation in their projections for gasoline consumption. The three *AEO2001* cases show significantly more distillate fuel consumption than do WEFA and DRI, mainly attributable to a higher projected rate of increase in freight travel.

The projections of net petroleum imports in the *AEO2001* low oil price case are well above those in the other forecasts, reflecting low production and high consumption projections. The projected percentage of petroleum consumption from imports, which is an indicator of the relative direction of production, net imports, and consumption, is also highest in the *AEO2001* low oil price case, followed by the DRI forecast. For 2010 the projected import share of consumption ranges from 52 percent (WEFA and IPAA) to 66 percent (*AEO2001* low oil price case). In 2020 all the forecasts show increased reliance on imports, with the highest projection being 70 percent in the *AEO2001* low oil price case. WEFA projects the lowest share of imports in 2020 at 56 percent, because it projects significantly lower petroleum consumption than in the other forecasts. WEFA actually projects lower import shares than were projected in its own forecast last year for both 2010 and 2020 and is the only forecast with lower projected import shares than last year.

Forecast Comparisons

Table 27. Comparison of petroleum forecasts (million barrels per day, except where noted)

Projection	AEO2001			Other forecasts			
	Reference	Low world oil price	High world oil price	WEFA	GRI	DRI	IPAA
2010							
World oil price (1999 dollars per barrel)	21.37	15.10	26.66	18.48	18.17	18.65^a	NA
Crude oil and NGL production	7.50	6.85	7.93	7.55	8.50	7.71	7.52
Crude oil	5.15	4.51	5.54	5.43	5.81	5.49 ^b	5.49
Natural gas liquids	2.35	2.34	2.39	2.12	2.69	2.22	2.03
Total net imports	13.92	15.31	12.95	11.11	NA	14.68	12.37
Crude oil	11.54	11.89	11.16	10.23	NA	10.94	NA
Petroleum products	2.38	3.42	1.79	0.88	NA	3.74	NA
Petroleum demand	22.70	23.30	22.29	21.57	21.39	23.86	23.65
Motor gasoline	10.11	10.31	10.03	9.10	8.51	10.61	NA
Jet fuel	2.18	2.20	2.16	1.92	2.20	2.37	NA
Distillate fuel	4.47	4.57	4.44	4.09	4.15	4.33	NA
Residual fuel	0.58	0.77	0.55	0.76	1.12	0.91	NA
Other	5.36	5.46	5.11	5.70	5.41	5.64	NA
Import share of product supplied (percent)	61	66	58	52	NA	62	52
2020							
World oil price (1999 dollars per barrel)	22.41	15.10	28.42	20.41	NA	21.16^a	NA
Crude oil and NGL production	7.94	7.16	8.67	7.49	NA	7.38	NA
Crude oil	5.05	4.35	5.78	5.07	NA	4.95 ^b	NA
Natural gas liquids	2.89	2.81	2.89	2.42	NA	2.43	NA
Total net imports	16.51	18.77	15.17	13.26	NA	18.17	NA
Crude oil	12.14	13.31	11.45	11.39	NA	11.33	NA
Petroleum products	4.37	5.46	3.72	1.87	NA	6.84	NA
Petroleum demand	25.83	27.00	25.28	23.81	NA	27.11	NA
Motor gasoline	11.33	11.67	11.11	9.68	NA	12.05	NA
Jet fuel	2.88	2.91	2.84	2.58	NA	3.16	NA
Distillate fuel	5.10	5.47	5.06	4.45	NA	4.73	NA
Residual fuel	0.60	0.80	0.58	0.84	NA	0.88	NA
Other	5.92	6.15	5.69	6.27	NA	6.29	NA
Import share of product supplied (percent)	64	70	60	56	NA	67	NA

^aComposite of U.S. refiners' acquisition cost.

^bIncludes shale and other.

NA = Not available.

Sources: **AEO2001**: AEO2001 National Energy Modeling System, runs AEO2001.D101600A (reference case), LW2001.D101600A (low world oil price case), and HW2001.D101600A (high world oil price case). **WEFA**: The WEFA Group, *U.S. Energy Outlook* (2000). **GRI**: Gas Research Institute, *GRI Baseline Projection of U.S. Energy Supply and Demand*, 2000 Edition (January 2000). **DRI**: Standard & Poor's DRI, *U.S. Energy Outlook* (Spring/Summer 2000). **IPAA**: Independent Petroleum Association of America, *IPAA Supply and Demand Committee Long-Run Report* (April 2000).

Forecast Comparisons

Coal

The coal forecast by DRI is the most similar to the *AEO2001* coal forecasts; however, the coal forecasts by DRI, WEFA and GRI/Hill [96] all project lower production and overall consumption than does *AEO2001* (Table 28). The differences stem from differences in assumptions related to expected economic activity and sectoral growth in electricity demand and whether the forecast includes the effects of emissions limits proposed by the U.S. Environmental Protection Agency, which could force the retirement of many older coal plants. *AEO2001* represents the provisions of the State implementation plan (SIP) call for 19 States where NO_x caps were finalized but does not incorporate revised limits on emissions of particulate matter. The DRI forecast projects substantial gains in efficiency for coal-fired generators.

EIA projects growing domestic consumption over the forecast horizon in combination with shrinking real coal prices. DRI expects some expansion of electricity and industrial sector coal consumption followed by declines beginning after 2010. Similarly, GRI/Hill predicts increases in coal consumption until 2013 followed by a decline. WEFA is the most pessimistic about coal consumption in the electricity generation and industrial sectors.

The differences among the forecasts for coal exports are significant. U.S. coal exports declined from 90 million tons in 1996 to 58 million tons in 1999, and net coal exports in 1999 (after adjustment for imports) were 49 million tons. EIA expects net exports to decline to 35 million tons in 2015 and remain approximately at that level through 2020. GRI/Hill projects an even more dramatic decline in net exports to 4 million tons in 2015 and 2 million tons in 2020, reflecting declining coal demands by

importing countries and strong competition from other producers such as Australia, South Africa, and Colombia. The projections for a long-term decline in exports are based primarily on the inability of the U.S. mining industry to keep pace with strong price competition by other exporters and the loss of markets as Europe moves away from coal for environmental reasons. Both DRI and WEFA, however, project relative stability in U.S. net coal exports, at 57 million tons in 2015 and 55 million tons in 2020 (DRI) and 51 million tons in 2015 and 52 million tons in 2020 (WEFA).

The *AEO2001* and WEFA price forecasts for national average minemouth coal prices (all shown in 1999 dollars) are fairly close. The GRI/Hill minemouth price projections are somewhat lower than the other forecasts because they exclude exported and metallurgical coal in the calculation. (Exported and metallurgical coal tend to be more expensive.) In dollars per million Btu, WEFA's slightly lower projected prices at \$0.62 in 2015 and \$0.59 in 2020 indicate a slightly higher average Btu per ton conversion factor, which in turn indicates a higher proportion of bituminous (over subbituminous) coal in the WEFA forecast.

The coal forecasts reviewed provide a broad range of views, reflecting the great uncertainties facing the U.S. coal industry as it must simultaneously adapt to the financial pressures arising from increasing environmental restrictions on coal use (both here and in Europe), deregulation of the U.S. electricity generation industry, and increasing competition from the younger coal fields of international competitors. The uncertainties are, and will continue to be, passed on to U.S. coal producers in the form of demands for higher quality products at ever lower prices.

Forecast Comparisons

Table 28. Comparison of coal forecasts (million short tons, except where noted)

Projection	AEO2001			Other forecasts		
	Reference	Low economic growth	High economic growth	WEFA	GRI/Hill	DRI
2015						
Production	1,294	1,259	1,352	1,078	1,123	1,210
Consumption by sector						
Electricity generation ^a	1,149	1,117	1,203	971	1,070	1,057
Coking plants	21	21	21	25	20	22
Industrial/other ^a	90	88	94	34	71	75
Total	1,261	1,226	1,318	1,030	1,162	1,154
Net coal exports	35	35	35	51	4	57
Minemouth price						
(1999 dollars per short ton)	13.38	13.23	13.28	13.39	12.81 ^c	NA
(1999 dollars per million Btu)	0.66	0.65	0.65	0.62	0.58 ^c	NA
Average delivered price, electricity						
(1999 dollars per short ton)	20.25	19.96	20.65	22.13 ^b	22.41	20.73
(1999 dollars per million Btu)	1.01	1.00	1.04	1.08	1.06	0.99
2020						
Production	1,331	1,279	1,461	1,124	1,101	1,196
Consumption by sector						
Electricity generation ^a	1,186	1,138	1,311	1,015	1,050	1,044
Coking plants	19	19	19	24	19	21
Industrial/other ^a	91	88	97	34	61	76
Total	1,297	1,245	1,426	1,073	1,130	1,141
Net coal exports	36	36	36	52	2	55
Minemouth price						
(1999 dollars per short ton)	12.70	12.79	12.80	12.73	12.62 ^c	NA
(1999 dollars per million Btu)	0.63	0.63	0.64	0.59	0.57 ^c	NA
Average delivered price, electricity						
(1999 dollars per short ton)	19.45	19.11	19.83	21.31 ^b	22.01	19.76
(1999 dollars per million Btu)	0.98	0.96	1.01	1.04	1.04	0.94

^aWEFA includes cogeneration in the electricity generation category, whereas the other forecasts include it under industrial/ other.

^bComputed using a conversion factor of 20.495 million Btu per short ton from the Technical Appendix.

^cGRI's minemouth prices represent an average for domestic steam coal only. Exports and coking coal are not included in the average.

NA = Not available.

Btu = British thermal unit.

Sources: **AEO2001**: AEO2001 National Energy Modeling System, runs AEO2001.D101600A (reference case), LM2001.D101600A (low economic growth case), and HM2001.D101600A (high economic growth case). **WEFA**: The WEFA Group, *U.S. Energy Outlook* (2000). **GRI/Hill**: Gas Research Institute, *Final Report, Coal Outlook and Price Projection*, Vol. I, GRI-00/0019.1, and Vol. II, GRI/0019.2 (April 2000). **DRI**: Standard & Poor's DRI, *U.S. Energy Outlook* (Spring/Summer 2000).